OBSERVATIONS ON THE OPERATION OF RAPID SAND FILTER PLANTS[1]

By J. W. Ellms[2]

It is now over thirty years since the Massachusetts State Board of Health began its investigation of the water supplies of Massachusetts. At that time the study of the physical and chemical characteristics of natural waters was regarded as of prime importance, comparatively little attention being paid to their bacteriological content. The microscopical examination of waters for algae, diatoms, protozoa and similar organisms had also been shown to throw considerable light on the quality of surface waters for public supplies. As bacteriological technique was perfected, and as the relation between polluted water and certain diseases became more evident, the examination of waters for the number of bacteria which they contained, together with attempts to isolate certain species of bacteria, came more into vogue.

The early experimental work on the merits of rapid sand filters for purifying public water supplies, carried on at Providence, Louisville, Cincinnati, Pittsburgh, New Orleans and Washington, required the utilization of all the available methods of examination, and as a result of this work analytical methods were much improved, and their interpretative value much better understood. The various kinds of natural waters experimented with in these investigations impressed upon the workers the need for careful standardization of the methods of analysis. This idea took concrete form in the appointment of a committee on this subject by the American Public Health Association. The original work has been revised from time to time, and is at present in process of further revision in order to keep pace with our advance in knowledge on these subjects. In order that this revision of methods may be adequate, the membership of the Committee should be enlarged to include representatives of several of the other national scientific associations, such as the

[1] Read before the Central States Section at Columbus on September 27, 1921.

[2] Consulting Engineer, The Frazier-Ellms-Sheal Company, Cleveland, Ohio.

American and New England Water Works Associations, the American Chemical Society, the American Society of Bacteriologists and the American Society of Microscopists. A revision of these methods by such a committee would be authoritative in the broadest sense, and would establish a firm basis for comparison of results and for interpretation of those results.

The control of the operation of rapid sand filter plants is based largely upon accurate information obtained in the laboratory. If this information is immediately available, so that processes may be modified during the progress of the water through the plant, or if it can only be obtained many hours after the water has been treated, the data secured should be utilized directly or indirectly by the operator in order to guide him in handling the plant. This is much easier said than done, even if we grant the accuracy of the laboratory methods. Facts are of small value unless they are properly interpreted, and unfortunately there is not the consensus of opinion in regard to interpretation even amongst those presumably qualified to express an opinion.

To illustrate conditions commonly met with, we do not agree always upon the merits of fine versus coarse flocculation after treatment with chemicals, upon the proper periods of sedimentation, upon the velocities that may safely be used in conduits, upon the means for preventing incrustation upon filter sands when lime is used, upon the completeness of the precipitation of aluminum hydroxide where alum is employed, upon the size of the sand grains that will produce the greatest bacterial removals, upon the extent to which chlorination of filter effluents may be carried to offset lowered filter efficiency, upon the significance of secondary bacterial growths in settling basins and perhaps filters, upon the weight to be attached to the presence of B. coli, and upon numerous other questions constantly arising from the data that the laboratory produces, and from observation of plant conditions. That waters differ widely in character and consequently in their susceptibility to purification processes is axiomatic. Nevertheless, the most experienced operators are inclined to draw conclusions from too little data and from too limited knowledge of the varied waters which are being purified for public consumption.

It cannot be too strongly stated that many of the fundamentals of rapid sand filter plant control are the result of the accumulated experience of more than twenty-five years' labor in extensive experi-

mental work, costing many thousands of dollars, as well as the practical operation of numerous plants purifying waters of widely varying character. The utilization of new principles which are the result of scientific research, but which have not been tried out on a practical scale, requires caution and an open mind. What may be true under controlled conditions when demonstrated in a laboratory beaker, may be far from true under the conditions existing in a large filter plant. Unforeseen conditions, and factors that cannot be controlled may so modify the original principle that its value for practical purposes is nil.

In spite of the advances made in the art of water purification during the past quarter of a century, no true scientist would claim that the art has been perfected or further progress impossible. The careful scrutiny of all new ideas advanced and their subjection to rigid, practical tests are not only scientific, but wise. The revolutionizing of an art requires the establishing of new principles beyond any question of doubt, and not until this is done may past practices be thrown into the discard.

Water purification in its broadest sense may perhaps include the purification of drinking water, the softening of water for industrial purposes, the disposal of sewage, and the adequate treatment of industrial waste liquors of many kinds. The field for research work is enormous, and the problems involved intricate. There is plenty of room for many workers. If each contributes his mite to the problems presented to him, he will have done his part.

The points I wish to bring out in this paper may be summarized as follows:

1. We must have a set of standard methods of analysis which will be authoritative and adequate for the problems to be solved.
2. We must formulate our problems in such a manner that it is evident to all what the questions at issue are.
3. We must be receptive to new ideas, examining them with candor, neither accepting nor rejecting them without rigid testing.
4. Finally we should hold fast to that which has been established by costly experiments and practical operating conditions, until new methods have demonstrated beyond doubt that something better is possible.